DISSERTATION ON

A STUDY ON AETIOPATHOGENESIS AND MANAGEMENT OF EXTRA HEPATIC BILIARY CALCULI

M.S.DEGREE EXAMINATION
BRANCH – I
GENERAL SURGERY

THANJAVUR MEDICAL COLLEGE AND HOSPITAL

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI

MARCH – 2009

CERTIFICATE

This is to certify that dissertation entitled **A STUDY ON AETIOPATHOGENESIS AND MANAGEMENT OF EXTRA HEPATIC BILIARY CALCULI** is a bonafide record of work done by **Dr. A. SANDIP CHANDRASEKAR**, in the Department of General Surgery, Thanjavur Medical College, Thanjavur, during his Post Graduate Course from 2006-2009 under the guidance and supervision of **PROF. DR. G. AMBUJAM, M.S. FICS**. This is submitted in partial fulfillment for the award of **M.S. DEGREE EXAMINATION- BRANCH I (GENERAL SURGERY)** to be held in March 2009 under the Tamilnadu Dr. M.G.R. Medical University, Chennai.

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DECLARATION

I declare that this dissertation entitled **A STUDY ON AETIO PATHOGENESIS AND MANAGEMENT OF EXTRA HEPATIC BILIARY CALCULI** is a record of work done by me in the department of General Surgery, Thanjavur medical college, Thanjavur, during my Post Graduate Course from 2006-2009 under the guidance and supervision of my unit chief and professor and head of the department **PROF. DR. G. AMBUJAM, M.S. FICS.** It is submitted in partial fulfillment for the award of **M.S. DEGREE EXAMINATION- BRANCH I (GENERAL SURGERY)** to be held in March 2009 under the **Tamilnadu Dr. M.G.R. Medical University, Chennai.** This record of work has not been submitted previously by me for the award of any degree or diploma from any other university.

DR. A. SANDIP CHANDRASEKAR

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INTRODUCTION

Calculus disease of biliary tract is the one of the most common problems affecting the digestive tract.

Extra-hepatic biliary calculi account for more than 95% of it. It includes cholelithiasis and choledocholithiasis. Autopsy reports have shown a prevalence of gall stone disease in 11% – 36%. Gallstone disease once more common in western world the incidence is increasing considerably in India, possibly due to change in dietary habits and lifestyle modifications.

Exact incidence in India is not known but prevalence in Indian males & females is estimated to be 4% and 6% respectively. Because of extensive studies of etiology of gallstone disease and better understanding of pathogenesis and technological advancements in past three decades, the management has become more appropriate and effective.

Continued research on minimal invasive surgery especially after 1988 with advent of laparoscopic cholecystectomy followed by laparoscopic CBD exploration, endoscopic management of gallstones and CBD calculi, extra-corporeal shock wave lithotripsy has greatly improved and modernized the management of gallstone disease with minimal mortality and morbidity.

AIMS OF THE STUDY

1. To evaluate age, sex incidence, most common etiological factors for extra-hepatic biliary calculi

2. To illustrate varying clinical presentation.

3. To study various modes of management adopted in our institution.

4. To analyse biochemical types of stones prevalent in this part of country.

MATERIALS AND METHODS

Patients admitted in various surgical units of TMCH between august 2006 to august 2008 constitute the materials of this study.

All patients admitted with clinical diagnosis of cholelithiasis/CBD calculus and its complications were included this study. A total of 60 patients were studied.

A detailed history including dietary factors, life style habits, were elicited in all patients and thorough clinical examination was done in them.

All patients were subjected to basic blood, urine and biochemical evaluation including liver function test and USG abdomen. CT scan abdomen, MRCP were done in selected subjects.

Patients were operated. Operative findings noted, recorded and analysed. Epidemiological factors relevant to age, sex distribution were noted.

Bile was sent for bacteriological analysis, stones sent for its biochemical composition.

In all jaundiced patients, prolonged prothrombin time is corrected by vit k IM injection for 3 days prior to surgery.

Both open and laparoscopic cholecystectomy were performed for gallbladder calculi randomly and based on availability of laparoscope. For CBD calculi, open CBD exploration was done and drainage procedure was done either in form of T tube or biliary enteric anastomosis.

All patients received peri operative antibiotic. Those with CBD diameter of >1.5 cms are subjected to biliary enteric anastomosis.

HISTORICAL NOTE

Gallstones and CBD stones have been described long before the era of modern abdominal surgery. Numerous calculi were found in the mummy of a priestess of Amenen of the 21st Egyptian dynasty 1500BC. Vesalius and Fallopius in 16th century described gall stones in human bodies.

The first cholecystostomy was performed in 1867 by John stough hobbs and first cholecystectomy was performed by Carl laugenbuch in 1882 in Berlin.

The CBD exploration was carried out of Kurnmell in 1884 and first performed successfully by Thornton in 1887.

1891 – Oskar sprengel – choledochoduodenostomy

1890 – Harskeer – T-tube

1921 – Busckhardt and Mueller – Trans hepatic gallbladder puncture

1923 – Cole - cholecystography

1924 – Cotte - post surgical cholangiography

1974 – Kawaiet al – endoscopic sphincterotomy

1987 – Hourt – laparoscopic cholecystectomy

SURGICAL ANATOMY

At 4th week in development of human embryo, a projection appears in ventral wall of primitive foregut, cranial bud develops in to two lobes of liver whereas caudal bud becomes gallbladder and extra hepatic biliary tree

EXTRAHEPATIC BILIARY TRACT

Extra hepatic biliary tract consists of bifurcation of right and left hepatic duct, common hepatic duct, gallbladder, cystic duct and CBD. (fig.1)

Right and left lobes are drained by ducts originating as bile canaliculi in the lobules and the canaliculi empty in to canals of herring in interlobular triads, these canals are collected in to ducts and finally outside the liver, the right and left hepatic duct

Left hepatic duct is formed by the ducts draining segments II, III, IV of liver and has longer extra hepatic length of > 2 cm with greater propensity for dilatation as a consequence of distal obstruction

Right hepatic duct is formed by the right posterior (segments VI, VII) and right anterior (segments V, VIII) hepatic ducts and has a short extra hepatic length of 0.9 cm. Hepatic duct bifurcation is usually extra hepatic and anterior to portal vein bifurcation, with a length of 1-4 cms and diameter of 4 mm. common hepatic duct lies anteriorly in the hepato duodenal ligament and joins the cystic duct to form CBD.

Cystic duct:

Arises from gallbladder, joins common hepatic duct at an angle of about 40 degree.

Length of cystic duct and manner in which it joints hepatic duct varies and is of surgical importance.

Cystic duct contains variable number of mucosal folds, the valves of Heiester without valvular function.

Common bile duct:

Common bile duct is about 7-11cm in length and 5-10mm in diameter and divided in to 4 portions

Supra duodenal, retroduodenal, pancreatic, intramural.

Supraduodenal portion lies in the right free border of lesser omentum to the right of hepatic artery.

Retroduodenal portion descends behind the 1st part of duodenum and pancreatic portion tunnels the gland. Intramural portion takes an oblique path averaging 1.5cm through duodenal wall and receives main pancreatic duct inferiorly. Both end in Ampulla of Vater on postero-medial wall of 2nd part of duodenum 10cm distal to pylorus and is guarded by sphincter of Oddi.

GALLBLADDER:

Gallbladder is a pear shaped sac about 7-10cm long with a capacity of 30-50ml, located in gallbladder fossa at junction of quadrate lobe (segment IV) and the right lobe of liver along line of Rex and is enclosed within its peritoneal sheath on 3 sides.

Divided in to four anatomic areas. Fundus is rounded blind end that normally extends 1-2cm beyond liver's margin. Partial folding of fundus may result in 'Phrygian cap' deformity.

Body extends from fundus and taper's in to neck a funnel shaped area that connects with the cystic duct. Infundibulum is angulated posterior portion of body between neck and point of entrance of cystic artery. It may show an eccentric bulging on its medial aspect called Hartmann's pouch and is often associated with impaction of stones.

Calot's triangle is bounded by common hepatic duct medially, cystic duct laterally and cystic artery superiorly. It is considered by most to comprise the triangular area with an upper boundary of

inferior margin of right lobe of liver rather than cystic artery. (fig.2)

Thorough appreciation of anatomy of Calot's triangle is essential during cholecystectomy (aberrant right hepatic artery, aberrant or accessory hepatic duct also may pass through Calot's triangle).

Blood supply:

Gallbladder is supplied by cystic artery which arise usually from right hepatic artery (>90%) reaches the gallbladder behind the common hepatic duct and traverses through the hepato cystic triangle and divides in to anterior and posterior branch.

The extra hepatic bile ducts are supplied by right hepatic and cystic artery above and branches of gastroduodenal artery below with major trunk running along the medial and lateral walls of common bile duct referred to as 3'0 clock/9'0 clock position as shown in fig.3. Ligation of cystic duct should not be carried out too near the bile duct.

ANAMOLIES: (fig.4)

- Variation of cystic duct
- Variation of gallbladder
- Variation in arterial supply of gallbladder.

SURGICAL PHYSIOLOGY

BILIARY SECRETION

Bile is secreted continuously by the liver cells (hepatocytes) in to the biliary canaliculi. Daily secretion is 500 – 1000 ml per day. Bile is secreted at a pressure of 150 – 250 mm of water. If obstruction occurs, liver continues to secrete up to the pressure of 300 mm of water, there after

secretion ceases.

Hepatic bile is slightly alkaline and gallbladder bile is more acidic due to transport of hydrogen ions by gallbladder epithelium.

The primary bile salts are cholate and chenodeoxycholate, conjugated with taurine and glycine and excreted in to the bile. 98% is reabsorbed by enterohepatic circulation. In the intestine gut bacteria de-conjugates the primary bile salts and forms secondary bile salts deoxycholate and lithocholate.

Two important functions of Bile salts are

1) Formation of water soluble complexes with cholesterol, fatty acids and fat soluble vitamins and their absorption.
2) Reduction of surface tension and emulsification of fat.

Bile salts are powerful cholerectic which increases hepatic bile production. Cholesterol and Phospholipids synthesized in the liver are the principal lipids found in bile. The color of the bile is due to the presence of pigment bilirubin diglucoronide, which is the metabolic product of breakdown of Hemoglobin in the reticuloendothelial system. In the intestine, bacteria convert it in to urobilinogen which is absorbed and excreted in urine.

FUNCTIONS OF GALLBLADDER:

1) Stores the bile and concentrates it.
2) Periodically releases bile by contracting in response to meal.
3) Acidification of hepatic bile.
4) Production of glycol proteins.

CONTROL OF BILE FLOW

It is under control of neurogenic, humoral, and chemical stimuli. Vagal stimulation increases

the secretion of bile, while splanchnic nerve stimulation results in decreased bile flow.

Hydrochloric acid, partly digested proteins and fatty acids in the duodenum stimulate the release of secretion from the duodenum that in turn increases bile production and bile flow.

Cholecystokinin also increases the hepatic secretion of bile. Other substances which have effect on biliary secretion are VIP and GASTRIN.

In between meals, when sphincter of Oddi is closed, gallbladder fills up when the CBD pressure is high.

Substances which contract the gallbladder are:

1) Cholecystokinin
2) Cholinergic hormones
3) Motilin

Substances which relax the gallbladder are:

1) Pancreatic polypeptide
2) Somatostatin
3) Glucagons
4) VIP

AETIOPATHOGENESIS OF GALL STONES:

Inspite of extensive research in the field of gallstones nothing conclusively has been put forward regarding the etiology and exact sequence of events that leads to the formation of gallstones.

The major question is why gallbladder forms stones in few people alone. The subject of interest has turned towards what makes gallbladder a factory for gallstone production. Interrelationship of bile salt, cholesterol and phospholipids is shown in fig.5.

Most of the studies conducted were from the western world where cholesterol stones are common. Studies in India are limited and mixed stones are more prevalent in India.

CLINICAL CLASSIFICATION OF GALL STONES:

1. Pure cholesterol stone : 10%
2. Pigment stone : 15%
3. Cholesterol pigment mixed stone: 75 – 80%

These can be analysed by color chromatography, thin layer chromatography and X-ray diffraction. In 1924, Aschoff classified the stones in to 4 categories:

1. Inflammatory.
2. Metabolic:

   Pure pigment (calcium Bilirubinate) and pure cholesterol.
3. Combination stones:

   Primary – metabolic

   Secondary – Inflammatory
4. Stasis stones

   Primary stones of CBD

Cholesterol Stones:

Cholesterol is usually present as single crystal mainly as cholesterol monohydrate.

Cholesterol stones may also contain carbonate and calcium palmitate. They are usually single, light yellow or even pure white, rounded or oval, being compared to unripe mulberries.

Pure Pigment Stones (Calcium Bilirubinate):

They are multiple, small and dark. Two types are recognized:

1. Calcium Bilirubinate stones found in oriental countries are associated with Ascariasis or E.coli.
2. Pure pigment stones occurring without any infection but some times with hemolysis.

These stones are dark or reddish brown and fragile. Some stones are black or dark green.

Mixed stones:

These form the majority of the stones (75-80%) which are multiple and multifaceted. The central portion of the stones represents the events occurring during initial stages of stone formation. They contain cholesterol, pigments, protein and sometimes parasites.

RISK FACTORS FOR PIGMENT STONES:

DEMOGRAPHY:

Oriental countries are more affected than the western world. Indian studies at Aligarh College concluded that mixed stones are the predominant variety in India (Vijay Pal et al., 1980). But in Kashmir the situation is different. The cholesterol stones are common. (Khuroo et al. 1986)

Among the Orientals, Japan records the highest prevalence of pigment stones. Rural are more affected than Urban. This is ascribed to the fact that parasitic infestation of the biliary tract is common in rural Japan. But evidences supporting this are lacking.

In Asians, brown pigment stones are common, and frequently associated with E.coli infected bile. The location of stones also differs from the Cholesterol stones. The pigment stones mainly occupy the gall bladder and the common bile duct. Intrahepatic pigment stones are unknown.

HEMOLYTIC ANAEMIA:

Conditions with decreased life span of red blood cells including hemolysis from prosthetic heart valves, malaria, hemoglobinopathies and membrane defects like hereditary spherocytosis are associated with pigment stones but evidences are lacking.

ALCOHOLIC CIRRHOSIS:

Pigment stones are more common among patients with cirrhosis than among normal persons. The mechanism underlying this association is unknown.

INFECTED BILE:

This is the oldest theory of gallstone formation.

No infection – No stone.

The Naunya's theory has got general support. Hence the nidus of stones is formed not only by bacteria, but also by inflammatory exudates or cellular exfoliation, parasites and ova. Moynihan has aptly described "Gallstone is a tomb stone erected to the memory of organism within it". The most common infecting organism is Escherichia coli, a producer of Beta Glucuronidase which increases bile saturation by increasing unconjugated water insoluble bilirubin.

Addition of glucuronidase, to bile in vitro resulted in the precipitation of calcium bilirubinate. D-glucuronic acid, an inhibitor of glucuronidase prevented the formation of calcium bilirubinate. Mechanisms other than the deconjugation of bilirubin also are involved in the association of the pigment stones with biliary infection. Ascaris lumbricoides, Round worm eggs are effective nucleating agents for the precipitation of calcium bilirubinate in vitro and may play similar part in vivo. Over half of stones examined in a large series in Japan showed ova of Ascaris lumbricoides. Another report from Vietnam showed this roundworm eggs were found in 70% of gallstones there.

Parasitic infestation causes inflammation of the gallbladder as well as local chemical changes favorable to the precipitation of calcium salts.

Inflammation does the following

1. Reduces the gallbladder motility

2. Distorts the intrahepatic bile ducts.
3. Interferes with the concentrating ability of the gallbladder and impairs the cholesterol dissolving capacity of gallbladder bile.

AGE:

Like that of Cholesterol stones, the frequency of pigment stones increases with age. Predominantly seen during the 5^{th} to 7^{th} decade. Before the 1^{st} decade, pigments stones have been rarely reported in cases of congenital hemolytic diseases.

SEX:

According to various Western texts, female sex is not a risk factor for the pigment stone Indian studies show increased incidence in female sex. (Vijaya pal et al., 1980; Gupta, 1967).

OBESITY:

Has no definite role in the pigment stone formation. Pancreatitis, Total parenteral nutrition and the advanced primary hyperparathyroidism are associated with pigment stones.

RISK FACTORS FOR CHOLESTEROL STONES

DEMOGRAPHY:

Rate appears to be the highest in the Scandinavian countries and Northern Europe while North and South America have higher incidence. Sub Sahara and Asia report very low incidence. Puma tribes of Arizona have the highest prevalence around 70% due to its biological disposition to formation of the gallstones.

The prevalence of cholesterol stones is higher in North India. Kashmir in particular has the highest prevalence of the cholesterol stones.

AGE AND SEX:

The greatest incidence occurs between the 5^{th} and 8^{th} decade incidence is rare below 20 years old. In females gallstones tend to occur more than in males, irrespective of the age, race etc., after

puberty the ratio between female to male is 3:1 to 4:1.

Possible hypothesis are

1. Estrogen and its effects.
2. Progesterone and its effects.

ESTROGEN:

EXOGENOUS

Several studies have confirmed that an association between gall stone and use of exogenous estrogens, whether as oral contraceptives, post menopausal estrogen replacement or estrogen administered to men.

The possible mechanisms are

1. Decreased chenodeoxycholic acid.
2. Increased Cholesterol saturation.
3. Increased Cholesterol secretion.
4. Cholestasis occurring with estrogens.

ENDOGENOUS

A definitely higher prevalence of gallstones among the females are documented in many studies throughout the world. This sex difference appears around the age of puberty and disappears around menopause.

Like oral contraceptives, endogenous estrogen also reduces bile acid pool and increases cholesterol secretion and the saturation thereby increasing gallstone formation. Multiparity also shows an increased incidence of gallstones.

PROGESTERONE:

- Saturates bile
- Relaxes smooth muscle

- Impaired gall bladder emptying

PARITY:

With increasing parity, the gallstones are more common in young women probably due to repeated attacks on gallbladder by altered physiology of estrogen or

progesterone on the biliary composition and smooth muscle function of the biliary apparatus.

OBESITY:

A large study conducted in obese people (1006 samples) shows in men and women of the 5^{th} decade with obesity, there is an increased incidence of gallstones - 1.7% and 1.8% respectively. This is not very high when compared with that in the same age group without obesity. Various mechanisms of gallstone formation in these individuals are postulated.

1. Increased saturation of bile in obese individuals due to excessive biliary secretion of cholesterol.
2. Cholesterol synthesis is related to HMG COA reductase enzyme. HMG COA reductase production is related to plasma insulin which is higher in obese persons and high fat intake also increases this enzyme.

DRUGS:

EFFECTS OF CHOLESTEROL LOWERING DRUGS:

Clofibrate:

An increased frequency of the gallstones among users of clofibrate for heart disease has been shown in two large clinical trials. The specific mode of its action on

lipids is not known. These findings are suggestive of increased mobilization of cholesterol from body fat stores by clofibrate which predisposes them for stone formation.

Bile acid sequestrants – Cholestyramine and colestipol:

An increased incidence of gallstones among users of bile acid sequestrants has not been documented. When used alone they have no effect on Cholesterol and bile acid metabolism.

EFFECTS OF GASTRO INTESTINAL DISORDERS AND SURGERIES:

Ileal disease, resection and bypass:

Bile acids are absorbed throughout the length of the intestine, but especially in the ileum, where transport is more active, hence the incidence of gallstones are increased in ileal resection and bypass.

Truncal vagotomy:

Truncal vagotomy – gallbladder becomes dilated and distended – stasis – stone formation. This was long debated matter. But there is no definite increase in the incidence of the gallstones following truncal vagotomy, because the gall bladder becomes adapted to the situation in a matter of 3 months till then irregular emptying was noted.

Cystic fibrosis with pancreatic insufficiency:

An increased prevalence of the gallstones has been noted among children with cystic fibrosis. The possible mechanisms ascribed are

1. Increased mucus production and abnormal mucus
   ⇩
   Nucleation of stones
2. Interference with bile flow → stasis → promotes gallstone growth
3. Reduced bile acid pool due to interference of bile acid reabsorption due to poorly secreting pancreas.

CLASSIFICATION OF COMMON BILE DUCT STONES:

Biliary stones, in general, may be classified as predominantly cholesterol or predominantly pigment in composition.

Cholesterol stones – 95%

Pigment stones - 5%

PRIMARY COMMON BILE DUCT STONES:

The stones that are formed primary in the common bile duct are called primary stones and those

originating in the gallbladder are secondary stones. Almost all primary stones are of pigment stones.

There are two types of pigment stones – black and brown. Both types have calcium bilirubinate as their principal compound. Brown pigment stones occur primarily in the common bile duct and are closely associated with bacteria. Black pigment stones are found chiefly in gallbladder.

SECONDARY (RETAINED) COMMON BILE DUCT STONES:

Secondary common bile duct stones are those that have migrated into the biliary system from the gallbladder. Approximately 11% of patients with gallbladder stones will have associated common duct stones at the time of operation.

Retained common bile duct stones are those that present after cholecystectomy, with or without concomitant bile duct exploration, and are secondary rather than primary stones.

NATURAL HISTORY:

Gallstones:

Majority of patients with gallstone disease are asymptomatic and remain same throughout life. For unknown reasons some patient's progress to a symptomatic stage with biliary colic by a stone obstructing cystic duct.

Symptomatic gallstones may progress to complication related to gallstones like

Acute cholecystitis/ chronic cholecystitis

Mucocoele

Empyema

Gallstone pancreatitis

Choledocholithiasis with or without cholangitis

Cholecystocholedochal fistula

Cholecystoduodenal fistula

Cholecystoenteric fistula

Gallstone ileus /Gallbladder malignancy

Rarely complications of gallstones is presenting feature.

Asymptomatic gallstones are diagnosed incidentally on USG/CT scan/laparotomy

1-3% of asymptomatic individuals become symptomatic per year (table 1)

Complicated gallstone disease develops on 3-5% of symptomatic patients per year.

Over a 20year period about 2/3 rd of asymptomatic patients with gall stones remain symptom free.

CBD calculi:

The natural history of choledocholithiasis is unpredictable. Small stones may pass spontaneously into the duodenum without causing symptoms or they may temporarily obstruct the pancreatic duct, induce an episode of pancreatitis and then pass into the duodenum with relief of symptoms, stones that do not pass spontaneously may reside in the bile duct for long symptom free period and then suddenly precipitate an episode of jaundice or cholangitis.

Choledocholithiasis may appear in the following five ways:

i) Without symptoms

ii) Biliary colic

iii) Jaundice

iv) Cholangitis (intermittent pain, fever, jaundice – CHARCOT TRIAD)

v) Pancreatitis

The last four of these may appear in all possible combination.

Various presentations of gallstones are depicted in fig.6.

CLINICAL FEATURES AND DIAGNOSIS:

CALCULOUS DISORDER:

It depends on the site of the stone. A stone in the gallbladder may remain asymptomatic lifelong. But when it gets obstructed at the neck of the gall bladder, it results in cholecystitis. The obstruction at the neck may get relieved and the stone may fall back into the gallbladder or passed into the CBD.

In the common bile duct if the stone passes without obstruction it will produce only mild pain. But if it is obstructed, intermittent pain, fever, jaundice may ensue. It is called Charcot's triad. It is due to transient attacks of cholangitis. If this is accompanied by CNS disturbances and shock, it is called Reynauld's pentad. **SYMPTOMS:**

Silent gallstones: Asymptomatic

Acute cholecystitis:

1. Right hypochondrial pain referred to right scapula, right shoulder or rarely to left side.
2. Attacks may be precipitated by fatty foods or heavy meals.

Chronic cholecystitis:

In chronic cases abdominal distension, fullness eructation, flatulent dyspepsia following fatty meals is common.

SIGNS:

Acute cholecystitis:

1. Localized tenderness and rigidity
2. Cutaneous hyperesthesia at right 8^{th} or 9^{th} thoracic segments posteriorly (Boas sign)
3. Rarely a tender mass with adherent omentum

Chronic cholecystitis:

Gallbladder is usually not palpable. Except for right hypochondrial tenderness nothing is

specific.

Choledocholithiasis:

1. Charcot's triad.
2. Obstructive jaundice.
3. Pancreatitis.

Differential diagnosis for acute cholecystitis:

1. Perforated peptic ulcer.
2. Retrocaecal/subhepatic appendicitis.
3. Acute pancreatitis.
4. Liver abscess.
5. Coronary artery disease.
6. Right lobar pneumonia.

Differential diagnosis for chronic cholecystitis

1. Peptic Ulcer
2. Hiatus Hernia

ACALCULOUS CHOLECYSTITIS:

Acalculous cholecystitis patients usually have features of acute abdominal signs and symptoms (critically ill patients). Patients usually give history of major trauma or major surgery or patient may be critically ill under intensive care. Co morbid ailments include Multi Organ Failure Syndrome (MOFS).

INVESTIGATIONS:

1. **Plain abdominal Radiographs:**

Only 10% of Gallstones are radio-opaque. 10-20% of cholesterol stones and 50% of pigment stones are radio-opaque. The opacity is due to presence of ca2+ greater than 4% as carbonate or phosphate. Rarely calcification of Gall bladder wall (porcelain gallbladder) and pneumobilia can be detected (fig 7, 8)

2. **Oral cholecystography (OCG):**

Until mid 1970's OCG was gold standard for evaluation of Gall bladder disease. With advent of USG, hepatobiliary scintigraphy and CT scan, role of OCG has become very much limited, almost virtually eliminated from routine investigations of EHBC.

3. **USG abdomen:**

USG is initial investigation of any patient suspected of disease of biliary tree.

It is non invasive, no radiation exposure, readily available, relatively inexpensive but operator dependent.

Detects gallstones with sensitivity and specificity of >90% accuracy of 95% and false negativity of 2.8%

Criteria for Gallstone → Echogenic focus

Post acoustic shadow (fig.9)

Gravitational dependence

CBD is well visualized except for Retroduodenal position.

Normal CBD diameter is 4-8mm

Any duct measuring >6mm in symptomatic patients warrants further investigation.

Thickened gallbladder wall and local probe tenderness with pericholecystic fluid collection → acute cholecystitis (fig.10)

Contracted thick walled Gallbladder → Chronic cholecystitis

Dilated CBD /IHBR with Jaundice → Extrahepatic obstruction (fig.11)

In obstructive jaundice USG is useful in detecting site and cause of obstruction.

Things to be seen:

- Gall bladder wall thickened, calcification
- Distended / contracted gallbladder
- Gall stones/ Biliary sludge
- CBD status [size, dilatation, presence of stone, level of obstruction with presence of pneumobilia]
- Pancreatic status.[evidence of pancreatitis]

Sensitivity and specificity in detection of CBD calculi 80-85%

4. **CT Abdomen:**
    - Less operator dependent than USG and easily reproducible but with risk of radiation exposure
    - Inferior to USG in diagnosis of gallstones.
    - Major application is to define the course and status of biliary tree and adjacent structures.

5. **Biliary Radio nucleotide scanning (HIDA Scan):**
    - 99mTc – labeled derivatives of dimethyl iminodiacetic acid (HIDA) are injected IV.
    - 80% excreted in bile. Biliary tract are visualized in 60 minutes in fasting state.
    - Useful in diagnosis of acute cholecystitis appear as non visualised GB with prompt filling of CBD.
    - 95% sensitive and specific in diagnosis of acute cholecystitis.

Blood tests:

- Complete blood count.
- Liver function tests.
- Increased WBC → may indicate cholecystitis.
- Increased WBC with Increased bilirubin/ALP → cholangitis.
- Increased conjugated bilirubin, Increased ALP → cholestasis due to obstruction.
- Biliary colic → blood test will be normal.

INTRAVENOUS CHOLANGIOGRAM:

After 1970 with the advent of PTC, ERCP, USG and CT scan, nowadays cholangiogram is rarely done.

PERCUTANEOUS TRANSHEPATIC CHOLANGIOGRAPHY:

Fluoroscopy or image intensifier is ideal both for introduction of the needle and during the injection of the dye. The needle is introduced in the 8^{th} or 9^{th} intercostal space in the midaxillary line.

Indications:

- Obstruction in Biliary tract.
- To know the site of obstruction
- Failure of ultra sonogram and CT scan in showing dilated ducts in a case of obstructive jaundice case.

Complications:

Sepsis (most common)	3%
Biliary leak	1-2%
Hemorrhage	2%

Interpretation:

In a normal study both common bile ducts; right and left hepatic ducts are visualized. The cystic duct and the gall bladder may not be visualized. In a distal CBD obstruction absence of the gall bladder indicates cystic duct obstruction or cholecystectomy. The site of obstruction will be delineated clearly but cause may not be predicted always. Filling defects in the lumen indicates gallstones.

ENDOSCOPIC RETROGRADE CHOLANGIO PANCREATOGRAPHY (ERCP)

ERCP is far superior to CT scan and ultra sonogram, because of its accurate delineation of the anatomy of the biliary and pancreatic ducts.

The normal cholangiogram shows biliary system with a smooth outline of the CBD. A Normal CBD measure within 7 to 10 mm. Filling defects indicates gallstones. (fig.12, 16)

Indications:

- In post-cholecystectomy symptoms to demonstrate CBD stones.
- To know the level of obstruction.
- As a pre-therapeutic procedure before removing CBD stones.

Complications:

- Pancreatitis (0.7 to 7.4%)
- Asymptomatic hyperamylasemia (15% cases)
- Cholangitis (0.8%)

Interpretation:

Radiographically gallstones can be detected as filling defects in the ducts.

Limitations:

- Cost
- Experienced endoscopists needed

MRCP: (fig.13, 14)

- MRCP uses T2 weighted sequences to show bile ducts as high – signal – intensity structures.
- Though expensive MRCP is considered an accurate, non invasive technique for evaluation of biliary tree before therapeutic intervention or surgery in many places MRCP replaced conventional ERCP or PTC.
- Sensitivity and specificity in diagnosis of CBD calculi → 95% / 90%

ENDOSCOPIC ULTRASOUOND : (FIG.15)

- Most useful for evaluating patients who are at moderate risk of harboring bile duct stones and in who a diagnostic ERCP might pose too great risk of pancreatitis.
- EUS can be immediately followed by therapeutic ERCP during the same endoscopic session.
- Sensitivity – 84-100% specificity – 95-100%

RADIOISOTOPE SCANS:

A Rose Bengal and 99m Tc labeled derivatives of Iminodiacetic acid dimethyl (HIDA), Diethyl IDA or Isopropyl (DI5ID A) are used. Usual dose is 5 mg. 80% of the isotope is excreted in bile and 20% in the urine. This detects acute cholecystitis almost in all cases. Non visualization of gall bladder is diagnostic of acute cholecystitis.

The role of radioisotope scan is very much limited in the diagnosis of cholelithiasis. So this is not indicated in chronic calculus cholecystitis.

MANAGEMENT:

MEDICAL MANAGEMENT:

ORAL DISSOLUTION THERAPY:

Thistle and Schoenfield et al., (1971) were the first to show that oral administration of chenodeoxycholic acid to women with gall stones produced a significant rise in the ratio of cholesterol solubilising agents to cholesterol in bile.

Indications:

- Functioning gallbladder.
- Radiolucent gall stones.
- Stones < 6mm in diameter (optimal), <10mm (acceptable)
- Cholesterol stones.
- Patient unfit for surgery.

Contraindications:

- Chronic liver disease.
- Non functioning gall bladder.
- Radio opaque gall stones.
- Stones >1cm in Diameter.
- Inflammatory Bowel disease.
- Pregnancy.

Drugs used:

- Chenodeoxycholic acid
- Ursodeoxycholic acid

Chenodeoxycholic acid:

First bile acid used for dissolution, but abandoned because of side effects like

hepatotoxicity and diarrhea.

Ursodeoxycholic acid:

Used commonly, having equal efficacy with lesser side effects.

Dose: 8-10 mg /kg/day.

Treatment continued until stone dissolution is documented by two consecutive negative ultrasound performed 1 month apart. Treatment stopped if stone fail to dissolve after 6 months or partial in 6 months fails to dissolve completely by 2 years.

Drawbacks:

Success rate is only about 40%. If the treatment is discontinued the chance of increase in the size is almost 100%. Even after complete dissolution the recurrence rate is very high. Oral dissolution is unsuitable for our tropical setup for the following reasons (Nundy and Tandon, 1988).

1. Expensive and unavailable.
2. Considerable drop out of patients.
3. Poor patient compliance.
4. Tendency to induce calcification of gall stone during the treatment.
5. Cholesterol stones are rare in our country.

Extra corporeal shock wave lithotripsy:

First applied by sauerbruch and colleagues in 1985.

Rationale: To diminish surface to volume ratio.

To diminish stone size to allow small stones and debris to pass through.

Involves delivery of high pressure sound waves.

Indications:

Radiolucent stones.

Size <2cm in diameter.

Symptomatic without complications

Normal gallbladder function.

Efficacy: 40% success rate

Recurrence: 50% after 5 years

Side effects: Petichiae

Hematuria

Liver hematoma

Biliary pancreatitis (<2%)

Cystic duct obstruction (5%)

OPERATIVE TREATMENT OF CHOLELITHIASIS:

OPEN CHOLECYSTECTOMY:

A right paramedian or right subcostal incision is made. The whole biliary and pancreatic areas and the liver are examined for congestion, friability, and any signs of ascending cholangitis or stones in the bile ducts.

Exposure of the operative field:

A large abdominal pack is used to push away the colon and a Deaver's retractor pulls this down and to the left, so that the upper margin of the duodenum is exposed. A long rectangular type of retractor is placed medial to the gall bladder close to undersurface of the liver in order to rotate the liver slightly upward and thus a better view of portahepatis is obtained. The peritoneum over the free edge of gastro-hepatic omentum is incised for 2-3 cm near the area of the cystic duct and the portahepatis.

Cholecystectomy starting at the cystic duct:

This is the more generally accepted procedure. By securing cystic artery first, three things

are accomplished:

1. The subsequent dissection is carried out in a relatively dry field.
2. After the division of cystic artery, the cystic duct uncoils itself and will be straightened out and clearly defined up to the common bile duct.
3. It eliminates the danger of serious bleeding from tearing of the cystic artery through traction upon the gall bladder.

Cholecystectomy starting at the fundus: (fig.17, 18)

This method is adopted in conditions where the identification of the duct system is more difficult in acute or chronic cholecystitis.

Golden rules in case of difficulty:

1. Clear identification of colon, pylorus, and duodenum is a prerequisite.
2. Fine needle aspiration to locate hidden CBD in fibrous tissue.
3. In severe inflammation in the Calot's triangle, open the gall bladder and extract all the stones and bile, then do either subtotal cholecystectomy, with cauterization of the residual mucosal membrane and the cystic duct opening is closed by a catgut suture from within. An alternative is cholecystostomy.

Minicholecystectomy:

- Described by Dubois and Barthelot in 1982.
- Transverse 5 cm incision made lateral to midline in right upper quadrant.
- Cholecystectomy performed in a fundus to neck fashion.
- Effective alternative to traditional cholecystectomy.
- Less post operative morbidity, early return to work, reduced post operative pain, lesser hospital stay.

Partial cholecystectomy:

- Performed in distorted anatomy of Calot's triangle.
- Fundus of gall bladder opened and contents evacuated.
- Entire anterior wall of gall bladder is removed above the cystic duct.
- Posterior wall of Gall bladder is left in place and its mucosa is removed with a curette or scored with electrocautery.
- Cystic duct is ligated if it is clearly identified.

Mortality: 0.1 – 0.5%

Bile duct injury rate: 0.1 – 0.2%

Morbidity – 5 – 20%

CHOLECYSTOSTOMY:

A Surgical procedure of compromise. A life saving measure, which paves the way for safety at a later date for the performance of a definite operative procedure.

Indications:

1. Acute cholecystitis with gallstones:
    - When the patient is aged and toxic.
    - Unusual technical difficulties like anatomic obscurations, extreme obesity.
    - As a preliminary measure in suppurative cholangitis with obstruction of common bile duct.
2. Chronic calculous cholecystitis – when there are risks involved in excising the gall bladder.

LAPAROSCOPIC CHOLECYSTECTOMY:

It has become popular in just 5 years after its introduction by Mauret [1987].

It is the procedure of choice world-wide for uncomplicated cholelithiasis and cholecystitis.

Advantages and disadvantages are depicted in table 2

Technique:

Under GA or epidural anaesthesia, pneumoperitoneum is established with the patient in Trendelenberg position. Supra umbilical, epigastric, right mid clavicular and midaxillary 3-5 cm incisions are made for port insertion. Cholecystectomy is performed and the gall bladder is delivered through one of the port usually the epigastric. Clips are used instead of ligation since it is simple and easy to apply them. (fig.19, 20)

Indications:

- Cholelithiasis and biliary colic.
- Chronic calculous cholecystitis.
- Symptomatic gall bladder polyps.
- Resolved gall stone pancreatitis.

Contraindications:

Relative:

Previous abdominal operation

Minor bleeding disorder

Common bile duct stones

Absolute:

Acute cholangitis

Severe acute cholecystitis

Acute pancreatitis

Peritonitis

Portal hypertension

Pregnancy

Complications:

Peroperative bleeding

Periumbilical hematoma

Perforation of gastrointestinal tract

Chest pain

Spillage of bile and gall stones into the peritoneal cavity

Biliary tract injury

Subphrenic abscess

Subcutaneous emphysema

Mortality – 0.1%

Conversion rate – 3 – 7 %

Bile duct injury - 0.7 – 1 %

Vulnerable area for injury in laparoscopic cholecystectomy is depicted in fig.21.

Surgeons experience on risk of bile duct injury is shown in fig.22.

TIMING OF SURGERY:

- Early cholecystectomy (<3 days of diagnosis) is preferred over delayed cholecystectomy (weeks after the diagnosis)
- Multiple RCT shows patients undergoing early surgery experienced no increased peri operative mortality or morbidity and a shorter hospital stay compared to delayed surgery
- Results of early vs delayed laparoscopic cholecystectomy in acute cholecystitis are shown in table 3

Results comparing open vs laparoscopic cholecystectomy (table 6)

MANAGEMENT OF VARIOUS CLINICAL SITUATIONS

SYMPTOMLESS [SILENT] GALL STONES:

The previous controversy regarding the management of asymptomatic gallstones has been largely resolved by prospective studies which have shown that the vast majority of silent gall stones will not cause symptoms or complications during life. Comparative evaluation of expectant versus surgical management of asymptomatic gall stones has shown that cholecystectomy reduces marginally the life expectancy in addition to being substantially more costly.

Another argument for cholecystectomy in the past has been the prevention of gall bladder cancer, the development of which is known to be associated with the presence of gall stones. However, carcinoma of the gall bladder is rare and the overall operative mortality with the widespread adoption of prophylactic cholecystectomy in patients with silent gall stones would certainly exceed that due to cancer of the gall bladder by a significant margin. The evidence linking cholecystectomy with the development of colon cancer remains conflicting and cannot be used as a further argument against prophylactic cholecystectomy. There is no indication for cholecystectomy in the management of patients with asymptomatic gall stone disease [Cuschieri.A, 1988].

ACUTE CHOLECYSTITS: (fig.23, 24)

Initial treatment with nasogastric suction, intravenous fluids and electrolyte replacement therapy. Antibiotics and analgesics if required. Two surgical options are available. They are interval [delayed or elective] cholecystectomy and early cholecystectomy.

Interval Cholecystectomy:

This is the traditional approach where the acute episode is being managed conservatively and subsequently after the complete resolution of the acute episode, patients are admitted after 2-3 months for elective cholecystectomy. The rationale for this treatment is that difficulties are encountered during surgery in the acute inflammatory episode.

Early cholecystectomy:

This is being performed for acute cholecystitis increasingly now a days. The patient is operated electively on the next available operating list or within a few days of admission. This must be distinguished from emergency Cholecystectomy, which is done immediately after admission when gall bladder perforation is suspected. The results of several prospective clinical trials have shown clearly that early cholecystectomy is equally safer to elective cholecystectomy. Mortality and morbidity are same in both the situations. But elective cholecystectomy has several disadvantages:

1. Failure of conservative treatment 10-15%.
2. Premature further episodes while awaiting for the surgery 10-15%.
3. Patient failing to report 10%
4. When surgery becomes imperative between second and fourth weeks the incidence of iatrogenic injuries is very high.

Early cholecystectomy is best performed using the fundus first approach. It is customary to administer prophylactic antibiotics.

CHRONIC CALCULOUS CHOLECYSTITIS:

For the treatment of biliary pain non opiate analgesics preferably drugs are preferred because opiates may cause spasm of sphincter of oddi which cannot be countered by hyoscine. Antiemetics may be needed to control vomiting.

The definitive treatment of chronic cholecystitis is surgical cholecystectomy open or laparoscopic. There is little doubt that these patients should have their gall bladder removed as approximately 30% of them will develop complications if surgical treatment is delayed. The other option is non-surgical gallstone dissolution. It may be oral dissolution by drugs or extra corporeal shock wave lithotripsy.

TREATMENT OF CBD CALCULI :(table 5)

1. CBD stone associated with gallbladder stone

   Options:

- Laparoscopic Cholecystectomy / Laparoscopic CBD exploration
- ERCP stone extraction → Laparoscopic cholecystectomy
- Open cholecystectomy with CBD exploration followed by T tube drainage (fig.25, 26) or biliary enteric anastomosis (fig.27, 28)

2. CBD stones presenting after cholecystectomy
    - T tube present → choledochoscope stone removal via T tube tract
    - T tube not present - ERCP stone removal.

OPEN CBD EXPLORATION:

Technical considerations:

The decision to explore the common duct having been made, the area of the free edge of the lesser omentum is exposed.

The essential steps are the retraction of the right lobe of the liver upward, displacement of the duodenum down ward and retraction of the stomach to the left. The peritoneum over the anterolateral surface of the common bile duct divided and the duct is exposed.

Before the duct is opened a sample of bile is taken by needle aspiration and is sent for bacteriological examination. Two 3.0 stay sutures (coated vicryl) or PDS are placed on the anterior surface of the duct approximately 1 to 2 cm above the superior border of the duodenum and the duct opened longitudinally between them with a scalpel. The incision initially is enlarged to about 1.5cm.

Proximal exploration is carried out first. The catheter is passed sequentially into the common hepatic and the right and left hepatic ducts.

Completion choledochoscopy:

This procedure is now a days considered an essential step of exploration of the common bile duct since its regular use reduces the incidence of retained or missed stones to negligible levels.

After establishing that the lower ductal system is clear, the choledochoscope is withdrawn and reinserted proximally to inspect the hepatic ducts.

Throughout the inspection, any stones that are identified are extracted under vision using a dormia basket which is introduced through the operating channel of the choledochoscope. The basket is positioned distal to the stone before the wires are opened, the stone trapped with the right amount of closure to secure the stone without crushing it, and removed by with drawing the instrument and basket "en masse".

Drainage of common bile duct and closure of choledochotomy:

Although there are few surgeons who close the choledochotomy without drainage, this practice is unwise since temporary edema and obstruction at the lower end of the bile duct is inevitable.

REMOVAL OF DIFFICULT STONES:

1. Kocherisation of the duodenum and head of the pancreas and massage of the lower duct and impacted stone with two fingers. One placed behind the head of the pancreas and other anteriorly. This procedure may require simultaneous grasping of the stone with a Desjardin's forceps introduced through the choledochotomy.
2. Disintegration of the stone either by electro hydraulic lithotripsy using a probe attached to a spark generator or dye laser.
3. Transduodenal sphincteroplasty.

SURGICAL DRAINAGE OF THE COMMON BILE DUCT:

Regardless of the approach used, open or laparoscopic, there are patients in whom ductal clearance of stones provides inadequate treatment since these patients have distal benign stenotic disease of the lower choledochal sphincter. These patients require ductal drainage in addition to

removal of the calculi. This subgroup of patients can be identified by the following features.

1. Grossly dilated duct (>2 cm).
2. Large multiple pigment stones filling the common bile duct.

Other indications for choledochoduodenostomy are

1. One or several large stones within a dilated duct.
2. Multiple duct stones, in dilated ducts in elderly patients.
3. An impacted ampullary stone.
4. Stricture associated with chronic pancreatitis - SNAPE's SYNDROME.
5. Strictures from stone impaction.
6. Iatrogenic stricture.

Technique:

1. Side to side anastomosis:

   It is the procedure of choice in all indications except iatrogenic injuries and in malignant obstruction. The duodenum and pancreas are mobilized by Kocher maneuver. The CBD is incised longitudinally beginning at point at which it traverses the duodenum posteriorly and extends proximally for 2.5cm.

   The duodenum is incised longitudinally at its superior border for a distance of 1.5cm.

   A single layer anastomosis using 4-0 polypropylene is accomplished beginning posteriorly and positioning the knots on the outside of the anastomosis. The anterior anastomosis is performed by simple interrupted sutures. T tube is not needed; although it can be inserted proximally if the anastomosis is narrow.

2. End to side anastomosis:

   It is used in iatrogenic injury to the CBD or the common hepatic duct when mobilization of pancreas and duodenum can result in tension free anastomosis. The distal portion of

the transected duct is closed with interrupted 4-0 polypropylene. A 1 cm longitudinal opening is made in superior portion of duodenum using cautery. Beginning posteriorly the

anastomosis is performed using interrupted 4-0 polypropylene sutures placed 1-2 mm apart.

Complications of choledochoduodenostomy:

I) Bile leak:

Leakage of bile from the suture lines occur in a small number of cases. The closed – suction drain should not be removed if the drainage is bile stained. All such leaks will eventually close with conservative management. In rare case of a persistent leak, a carefully, placed transhepatic stent will hasten the closure by diverting bile through the stent.

II) Stricture:

All biliary - enteric anastomoses are subject to stricture. ERCP is done to confirm the presence of stricture.

Stricture – balloon dilatation – if fails – surgery.

III) The Sump Syndrome:

Food and debris may collect in the portion of the bile duct distal to side to side choledochoduodenostomy, which is said to serve as a sump.

The mechanism by which debris in the bile duct distal to the anastomosis could produce symptoms is not clear.

Choledochojejunostomy:

Choledochojejunostomy is indicated when there is iatrogenic injuries to CBD, at or proximal to the entrance of cystic duct with CBD stones.

Transduodenal sphincteroplasty:

Transduodenal sphincteroplasty is a viable alternative to choledochoduodenostomy.

The duodenum is mobilized by extensive Kocher maneuver. The duodenum is opened transversely opposite the papilla. Silk sutures are preplaced at either end of the incision, to elevate the duodenum and to limit the duodenostomy, to keep it from extending too close to the pancreas for safe closure.

The orifice of the major papilla is cannulated with lacrimal duct probes. If ampullary obstruction is caused by an impacted stone, it is easy to cut down on its anterosuperior aspect of the papilla (11'O clock position) opposite the pancreatic duct orifice (5'O clock position) and therefore, not endangering that structure.

The entire length of the musculature (lower, middle and upper choledochal sphincters) surrounding the lower end of the common bile duct is divided with the mucosal approximation at the cut edges by interrupted sutures.

Laparoscopic clearance of ductal calculi:

Laparoscopic clearance of ductal calculi usually is undertaken in patients undergoing laparascopic cholecystectomy.

Transcystic clearance:

Transcystic duct clearance is applicable to small calculi up to 1 cm in the distal common duct. It is unsuitable for proximal stones and multiple large occluding calculi where laparoscopic supraduodenal bile duct exploration is indicated. Cystic duct clearance can be performed under radiological control or by direct visual guidance. Irrespective of technique, the procedure must be performed before the cystic duct continuity is disrupted and before dissection of the gall bladder from the liver bed in commenced.

Radiologically controlled technique:

This technique is quicker than the endoscopically guided method and avoids the need for

dilation of the cystic duct. Multiple stone evacuations per single basket passage constitute further advantages. The radiologically guided technique necessitates the availability of modern real time fluorocholangiography.

The procedure consists of the following steps:

1. Initial cholangiogram
2. Insertion of dormia basket and stone capture.
3. Trawling and extraction of the stones:
4. Flushing and completion cholangiography.
5. Insertion of cystic duct drainage cannula

Visually Guided Technique:

This technique was pioneered by Dubois in France. It necessitates the dilation of the cystic duct followed by the introduction of a narrow flexible operating endoscope, attached to a CCD camera for visually guided transcystic extraction of ductal calculi.

The procedures consist of the following steps:

1. Initial cholangiogram
2. Insertion of guide wire.
3. Dilatation by balloon catheter.
4. Insertion of endoscope and removal stones through dormia basket.

Laparoscopic exploration and closure of the common bile duct: (fig.29)

The technique is indicated if the common duct diameter is larger than 1 cm and in the presence of a large or occluding stone load, and in patients with proximal stones.

1. Dissection of the common bile duct and choledochotomy.
2. Suction extraction.
3. Duct massage.
4. Extraction by biliary balloon.

5. Visually guided extraction with choledochoscope.

Common duct drainage:

The drainage of the bile duct is advisable after supraduodenal bile duct exploration, since obstruction owing to oedema is encountered for several days after this procedure. In addition, the drainage tube provides a ready access for post operative cholangiography as a final check against retained stones. As in open exploration of the common bile duct, there are two techniques that can be used to provide biliary drainage insertion of a T-tube and cystic duct drainage.

Suture closure of the common bile duct:

The incision in the common bile duct is closed by 2 to 3 interrupted 4-0 absorbable sutures. If a T-tube is placed, the choledochotomy is closed above the tube which then comes to lie at the bottom of the closed incision. If cystic duct cannula drainage is used, primary complete closure of the choledochotomy is performed. In either case, when the suturing has been completed, saline is injected through the cystic duct cannula or T-tube to ensue a water tight seal.

Management of patient with T-tube:

The T-tube is left on free closed drainage for 4 to 5 days when a post operative cholangiogram is performed. If this is satisfactory and the patient is fully ambulant with return of bowel function, the T-tube is spigoted and covered with a occlusive dressing and the patients is allowed to go home. This stage is usually reached 4 days after laparoscopic common bile duct exploration and 8 days after equivalent open procedure.

A sufficient period of time must be allowed for maturation of the T-tube tract (minimum of 10 days) and T tube cholangiogram is performed (fig.30, 31) before the T-tube is removed. In elderly, immunosuppressed or diabetic patients, a long period is advisable (3 weeks) before T – tube removal.

Management of Complications:

The clinical features that require medical attention and investigations during the postoperative period are

1. Persistent fever and leucocytes.
2. Persistent pain – beyond 24 hours
3. Biliary leakage through the drain.
4. Jaundice and rigors.

Biliary complications:

Biliary leakage and bile duct injury declare themselves in the postoperative period by pain and fever, with or without abnormal liver function tests and jaundice. Other manifestations include external discharge of bile. The initial investigation includes USG or CT for the detection of fluid collections. Biliary scintigraphy is useful in detection of biliary leakage.

Minor collections in the presence of an intact extrahepatic biliary tract can be treated by percutaneous drainage under radiological guidance. If the patient improves, no action needed. However in the presence of major leak, ERCP is mandatory.

If the ERCP demonstrates bile duct leakage, owing to slipped titanium clip, endoscopic management involves nasobiliary stenting or endoscopic sphincterotomy or both.

Endoscopic sphincterotomy and stone extraction:

The current treatment for ductal calculi is by endoscopic sphincterotomy and stone extraction. In patients requiring choledochotomy for symptomatic gall stone disease, endoscopic stone extraction is performed before the operation. Now the single stage laparoscopic surgical treatment is gaining favor.

Indications for endoscopic sphincterotomy are:

1. Poor risk patients.
2. Patients with cholangitis.
3. Patients with severe pancreatitis.
4. Some patients with failed laparoscopic stone extraction as an alternative to conversion
5. Related or recurrent stone after cholecystectomy.

Difficulties in stone removal in endoscopic approaches are:

1. Inaccessibility of the papilla.
2. Prior surgery such as Billroth II or Roux en Y reconstruction.
3. Variety of factors may hinder stone extraction including size, number, consistency, shape and location of stones and ductal factors such as contour, diameters at the level of and distal to the stone (s) and the presence of co-existing pathology such as stricture or tumor.

Adjuvant techniques for removal of difficult stones are:

1. Mechanical lithotripsy.
2. Extracorporeal shock wave lithotripsy.
3. Intra corporeal lithotripsy with laser.
4. Chemical contact dissolution therapy.

Complications of endoscopic sphincterotomy are:

1. Acute hemorrhage - 2 to 29%
2. Acute pancreatitis - 1.5 to 5.4%
3. Recurrence of common duct stones – 11%
4. Stenosis
5. Cholangitis – 1 to 2.7%

Residual calculi:

Incidence of residual, missed or retained calculi varies from 2 to 15 % and averages 8%. Routine completion choledochoscopy / cholangiography virtually abolish these complications. Retained ductal calculi following biliary tract surgery are diagnosed in the immediate post operative period by the post-operative T-tube cholangiogram or by the recurrent symptoms usually within 2 years of surgery. Urgent intervention is not indicated if the liver biochemistry is normal, the patient is asymptomatic and the T – tube cholangiogram shows no organic disease or significant dilatation.

Spontaneous passage is likely if the calculi are small (<3 mm) and may be aided by simple measures such as T-tube clamping. If the patient tolerates clamping and provided no untoward complication develops, such a conservative approach can be continued for a few weeks, at the end of which time the situation viewed radiologically.

The various methods available for the non-surgical management of retained stones are:

1. Flushing
2. Dissolution
3. Percutaneous stone extraction via the T-tube tract.
4. Endoscopic sphincterotomy and stones extraction.

Surgical management of missed stones is reserved for those patients in whom the above methods have failed or complications have developed during or after attempted endoscopic or percutaneous stone extraction.

Recurrent ductal calculi:

Ductal calculi presenting 2 years or more after an operation are generally regarded to be primary or recurrent. One study has identified suture material in 30% of cases. This finding stresses the importance of avoiding non-absorbable material during operation on the biliary tract. Internalization of metal clips used to secure the medial end of the cystic duct during laparoscopic cholecystectomy is now a well-recognized complication of this procedure. The exact pathology remains unclear. The internalized clip becomes covered with calcium bilirubinate to form a brown pigment stone.

The patients who develop this condition present between 6 and 12 months after the procedure with jaundice and or cholangitis. The condition is easily diagnosed on the ERCP films as the stone has a characteristic cat's eye appearance.

The management of patients with recurrent ductal calculi depends on their age and general condition. Endoscopic sphincterotomy and stone extraction is the first line of treatment and surgery

open or laparoscopic reserved if this approach fails.

In some situations, recurrent ductal calculi are often multiple and associated with gross dilation of the bile duct and in some cases obvious distal duct stenosis. This may be primary (papillary stenosis) or be secondary to iatrogenic trauma to the sphincter.

In patients with multiple ductal calculi, grossly dilated bile duct (>2 cm) or papillary stenosis, a drainage operation is indicated.

Techniques for the treatment of choledocholithiasis (table 5)

Algorithm for management of gallstone without suspicion of CBD calculi is shown in fig.32.

Algorithm for management of CBD calculi is shown in fig.33.

RESULTS OF THE STUDY:

1. **Number and sex:**

Total number of cases studied – 60

Male - 29(48.4%)

Female - 31(51.6%)

2. **Location of stone:**

Out of 60 cases studied 41 had only GB calculi. 19 had CBD calculi.

Total - 60

GB calculi – 41(68.3%)

CBD calculi – 19 (31.7%)

3. **Age distribution:**

Gall stone disease is more prevalent in 4^{th} and 5^{th} decade.

GB stone disease - 41 – 50 years (22 cases) (36.67%)

GB calculi - 41 – 50 years (15 cases) (36.59%)

CBD calculi - 41 - 50 years (7 cases) (36.84 %)

4. **Clinical presentation:**

GB calculi

Acute cholecystitis: 2 (4.9%)

Chronic cholecystitis: 38 (92.7%)

Mucocoele : 1(2.4%)

Empyema : -

Perforation : -

CBD calculi:

Obstructive jaundice: 15 (78.9%)

Cholangitis : 5 (26.3%)

Pancreatitis : 2 (10.5%)

5. **Accuracy of preoperative ultrasound - 100%**

6. **Surgical procedures performed:**

GB calculi

1. Emergency cholecystectomy - 2
2. Elective cholecystectomy - 39

   Open - 19

   Laparoscopic - 20
3. Cholecystostomy - nil
4. Partial cholecystectomy - nil

CBD calculi

1. Cholecystectomy with T tube drainage – 13 (68.4%)
2. Cholecystectomy, Choledochoduodenostomy - 2
3. Cholecystectomy, choledochojejunostomy - 2
4. Cholecystectomy with transduodenal sphincteroplasty – 2

7. **Number of stones:**

Multiple stones are more common than single stone.

Total - 60

Single stone – 20 (33.3%)

Multiple stones – 40 (67.7%)

GB calculi:

Single stone - 13(31.7%)

Multiple stones – 28(68.3%)

CBD calculi:

Single stone - 7 (36.9%)

Multiple stone - 12 (63.1%)

8. **Bacteriology of bile:**

Bile was sent for culture and sensitivity in all cases.

Culture positive in 19 cases (31.6%)

E Coli – 12 cases (63.1%)

Klebsiella – 4 cases (21%)

Others – 3 cases (15.8)

9. **Biochemical analysis of stone:**

Total - 60

Cholesterol stone - 5 (8.3%)

Pigment stone - 5 (8.3%)

Mixed stone - 50(83.3%)

GB calculi - 41

Cholesterol stone - 4 (9.7%)

Pigment stone - 3 (7.3%)

Mixed stone - 34(82.9%)

CBD calculi - 19

Cholesterol stone - 1 (5.3%)

Pigment stone - 2 (10.5%)

Mixed stone - 16 (84.2%)

10. Histopathology:

Gall bladder specimen sent for Histopathological examination in all 60 cases.

Acute cholecystitis - 2 (3.3%)

Chronic cholecystitis - 58(96.7%)

No evidence suggestive of malignancy.

11. Mean hospital stay:

Open cholecystectomy : 6 days

Laparoscopic cholecystectomy : 2 days

Open CBD exploration : 10 days

12. Post operatively during second week T tube cholangiogram was performed in 13 Cases. Found to be normal in all cases. No evidence of residual calculi.

13. Complications:

- Postoperative biliary leak occurred in 2 cases after open CBD exploration which was of low output type and managed conservatively.

- Wound infection occurred in 6 cases (10%) Pus let out and sent for culture and sensitivity. Parenteral antibiotics administered according to culture and sensitivity report. Secondary suturing performed later.

- No mortality in our series.

DISCUSSION:

60 Patients with extrahepatic biliary calculi were included in this study, out of which 4 patients (68.3%) had any gallstone and 19 patients (31.6%) had CBD calculi.

The incidence of extrahepatic biliary calculi increases with age, and higher incidence were found in 4^{th} and 5^{th} decade. Maximum incidence in 4^{th} and 5^{th} decades were also observed in Gupta et al (1967)/ Vijaypal et al (1980)/ Tyagi et al (1992) series.

Varying female preponderance from 2:1 to 4.5:1 has been observed in several studies. In our series, there is only slight female preponderance.

Among all patients reported abdominal pain at sometime during the course of illness the location is Right hypochondrium being 90% in our series, which is comparable to 84% in Vijay Pal et al (1980).

Majority of symptomatic gallstone disease patients present as chronic cholecystitis (92.7%). Other presentation being acute cholecystitis and mucocoele.

Majority of CBD calculi patients presented with Obstructive jaundice (78.9%). 2 patients presented as gall stone pancreatitis, 5 patients presented with cholangitis.

The accuracy of Pre-op USG was 100% in our series as compared to

Mesherry et al (1989) 90%, Schwartz et al (1990) 100%.

Majority of cases showed multiple calculi (66.7%) as compared to Farzaneh et al (2007) (62.5%).

MANAGEMENT:

Of 60 patients operated in our study cholecystectomy was done in 41 patients (68.3%)

Emergency cholecystectomy - 2 (features of peritonitis).

Elective cholecystectomy - 39.

In 50% of cases, laparoscopic cholecystectomy was done. Poor cardiorespiratory reserve,

previous surgeries and presence of CBD calculus were not taken up for laparoscopic procedure.

Out of 19 patients with CBD calculi,

T tube drainage - 13(68.4%)

Biliary enteric anastomosis – 4 (21.5%)

Transduodenal sphincteroplasty - 2 (10.5%) as compared to Girard RM et al with CBD exploration and T tube drainage rate of 92.8% (table 7)

Biliary enteric anastomosis was done because of large CBD diameter and presence of multiple CBD calculi.

Transduodenal sphincteroplasty was performed due to impacted stone in the lower end of CBD in one case and poor CBD anatomy due to extensive adhesions in the other case.

Right flank drain was kept in all cases of CBD exploration. No drains were kept for Open / Laparoscopic cholecystectomy.

Post operative course:

Oral feeds were started on next day of surgery in both laparoscopic cholecystectomy and open cholecystectomy. In case of CBD exploration, oral started once ileus gets relieved.

In patients with T tube, T tube cholangiogram was done in 2nd week. Normal in all 13 patients, T tube removed during 2nd week.

Post operative morbidity was significantly higher in case of Open cholecystectomy when compared to laparoscopic cholecystectomy.

2 patients had post operative biliary leak (3.3%) both after CBD exploration, presented with bilious fluid in drainage tube, which was of low volume and settled with conservative management.

Post operative wound infection was noticed in 6 cases (10%) 4 cases with CBD exploration and 2 cases with open cholecystectomy. Pus let out sent for culture and sensitivity. Managed with appropriate antibiotics. Secondary suturing was done later.

No iatrogenic bile duct injury in our series as compared to 0-0.7% injury in various large series (table 4)

No mortality in our series as compared to Mc sherry (1989) – 0.6-4%, Ganey et al (1996) 0.5%, Pappas et al(1990) 0% and Girard et al (2000) 0.3-1.6% (table 8)

Mean hospital stay for open cholecystectomy cases was 6 days, laparoscopic cholecystectomy 2 days and CBD exploration 10 days.

Bile culture was done in all cases. Positive in 19 cases (31.6%), as compared to Stewart et al (56%). Commonest organism isolated being E coli followed by Klebsiella. Iran Sattar et al 2002 and Ballal et al 2001 also isolated E coli as the commonest organism in bile culture.

In our series 83.3% of stones were of mixed type as compared to Ganey et al (70%), Vijay pal et al (91.3%), Bansali (86%)

SUMMARY AND CONCLUSION:

Gallstone disease is the commonest disease involving biliary tract and is associated with significant morbidity and mortality. Patients with gallstones are not a homogenous group. They are now being detected with greater frequencies with advent of USG and CT scan. 60 cases of well documented EHBC patients admitted in TMCH during period between August 2006 - August 2008 were studied in depth.

The following conclusions were made in our study:

- Age incidence varies between 15 – 74 years and mean age of incidence is 45 years. Patients of 4^{th} and 5^{th} decade were the commonest victims.
- Slight female preponderance (51.6%) was observed in our study.
- Right hypochondrial pain was the commonest presentation of gallstone disease.
- USG was invaluable in diagnosis of gallstones because of simplicity, safety, repeatability and an accuracy of 100% in our series.
- Mixed stones were the commonest variety in our study.
- Laparoscopic cholecystectomy is the most widely followed method of surgical treatment. Cholecystectomy starting at Calot's triangle is the commonest technique used.
- Mortality rate in our series is 0%.
- Open CBD exploration with T tube drainage is commonest procedure adopted for CBD calculi in our series.
- Bile culture was positive in 47.4% of cases E.coli being commonest organism isolated.

- The commonest Histopathological change associated with gallstone was chronic cholecystitis, associated malignant change in Gall stone disease is nil in our series.

Medical dissolution of stone though theoretical, is not very popular with our hospital patients because of non-availability, laparoscopic cholecystectomy is now replacing open cholecystectomy, with availability of instrument, more of laparoscopic cholecystectomy is being carried out replacing open cholecystectomy. However open cholecystectomy has its own indications. It is therefore necessary that a surgeon should have adequate knowledge and experience in this field. Open CBD exploration is being followed in our institution because of lack of expertise in laparoscopic CBD exploration and non availability of ERCP even though they produce better results.

BIBLIOGRAPHY

1. Alexander Mcgreegor 1984, A synopsis of surgical anatomy 11th edition.
2. Alfred Cusheiri 2002 essentials of surgical practice fourth edition.
3. Alfred Cusheiri, George bersly 1991, Laparoscopic cholecystectomy volume 159; 3 page 273.
4. Anderson.T, Liver and Gall bladder disease before and after very low calorie diets. A.M.J. Clinical Nutr. 1992 Jul:56 2355 – 2395.
5. Bailey and Love 2004 Short practice of surgery 25th Edition.
6. Benhoft 1984 – composition and morphology and classification of gall stones AJS 148:77 – 79.
7. Benard siegel 1989 radio diagnostic procedures in surgery 1st Edition.
8. Bowen JC, Brenner HI, Macle. WF Gallstone disease patho physiology epidemiology, natural history and treatment options. 1992 MCNA. SEP 76 [5] 1143 – 1157.
9. CsendesA, et al, 1998: Present role of classic pen choledochotomy in the surgical treatment of Patients with CBD stones wond J surg 22: 1167-1170.
10. EJ Williams et al, J Green et al Guidelines on management of CBD stones BMJ Gastroenterology Oct – Dec 2008 164 – 177.
11. Farguharson 2003 Text book of operative surgery, 8th edition 381-399.
12. Ganong short text book of physiology 1999.
13. Goswitz, bacteria and biliary tract disease 1974 AJS 128:644-646.
14. Gupta et al Prevalence of Gall stone disease 1985 IJS Vol.47.
15. Khuroo Et al prevalence of Biliary tract disease in India, 1986 gut30:201-205.
16.

17. L.H. Blumgart surgery of the liver, biliary tract and Pancreas 4th edition. 477-546
18. Lovimer JW, et al, 1997: Management of Choledocholithiasis in the time of laparoscopic cholecystectomy. Am.J.surg 174:68-71.
19. Mcsherry C.K, 1989 cholecystectomy; the gold standard AJS.206; 242-246.
20. North American clinics of gastroenterology 1991.3rd Edn.0885-0889.
21. Nijihawan.S, RR rai, 1992 epidemiology of gallstones in India JAPI vol.40 NUMO.
22. Recent advances in surgery 14, 15 and 16th edition.
23. Rob and Smith operative surgery 1989, abdominal surgeries vol 3rd Edition.
24. Rodney maingot's, 2002 abdominal operations 10th Edition.
25. Sabiston text book of surgery 17th edition.
26. Sauerbruch T, et al, 1986: Fragmentation of gall stones by ECSW.N Eng J med 314: 818 - 822.
27. Schwartz's principles of Surgery – 8th edition 1187 – 1195.
28. Shackelford surgery of Alimentary tract – 6th edition. 1440 – 1451, 1471 – 1480.
29. Sleisenger and Fordtran's GI and liver disease 8th edition.
30. Surgical clinics of North America, biliary tract diseases.
31. Tygat.N, maheshwari, 1992 July JIMA, Morphological changes in diseased Gall bladder.
32. Vijay pal, clinicopathological study of cholecystitis IJS 426 – 431.